Structural Study of Single Crystalline i-Zn-Mg-Dy at high Pressure and high Temperature

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In order to understand the origin of the structural stability of quasicrystals, it is important to investigate the pressure and temperature dependence of their structures. Quasicrystalline phases in the Zn-Mg-R (R = rare-earth and Y) alloys are classified as the Frank-Kasper type. Both the icosahedral and decagonal phases have been obtained in the alloys, which are thermodynamically stable at ambient conditions and reveal a high structural perfection [1]. The icosahedral Zn-Mg-Y quasicrystal is found to be stable at high pressures up to 70GPa at room temperature [2]. The hardness seems to be primarily governed by the complexity of the structure and the bonding strength. At room temperature, Zn-Mg-R quasicrystals exhibit a strong indentation size effect with the hardness increasing with decreasing load. This effect becomes inverted at higher temperatures [3]. Therefore it is interesting to perform structural studies at HP/HT.

We will report on the results of an in-situ single crystal x-ray diffraction study on i-Zn-Mg-Dy up to ca 12GPa and 873K using a heatable diamond anvil cell. The icosahedral quasicrystal is found to be essentially stable within the experimental framework.

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